

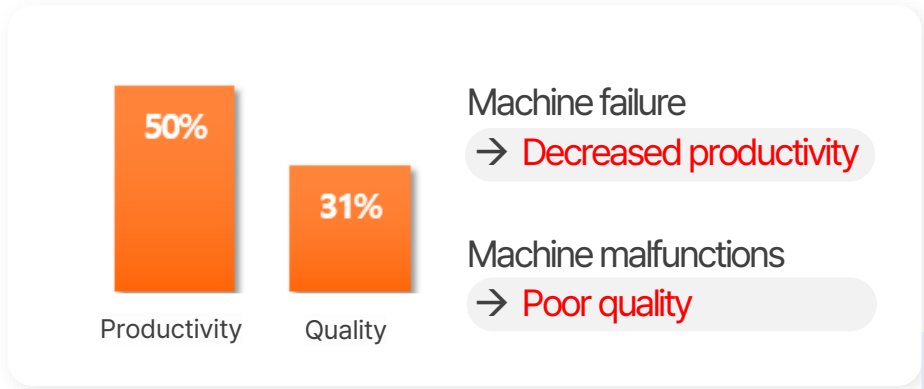
# The Global No.1 in AI Ultrasound Solutions



MOVIC Lab  
2024.10

# The Importance of manufacturing machine management

- Machine faults can cause **significant damage**, so **effective equipment management** is crucial for prevention.
- **Detecting early signs of faults** in real-time and performing **predictive maintenance** before a breakdown is essential.



Source: AT Kearney, Plant Service

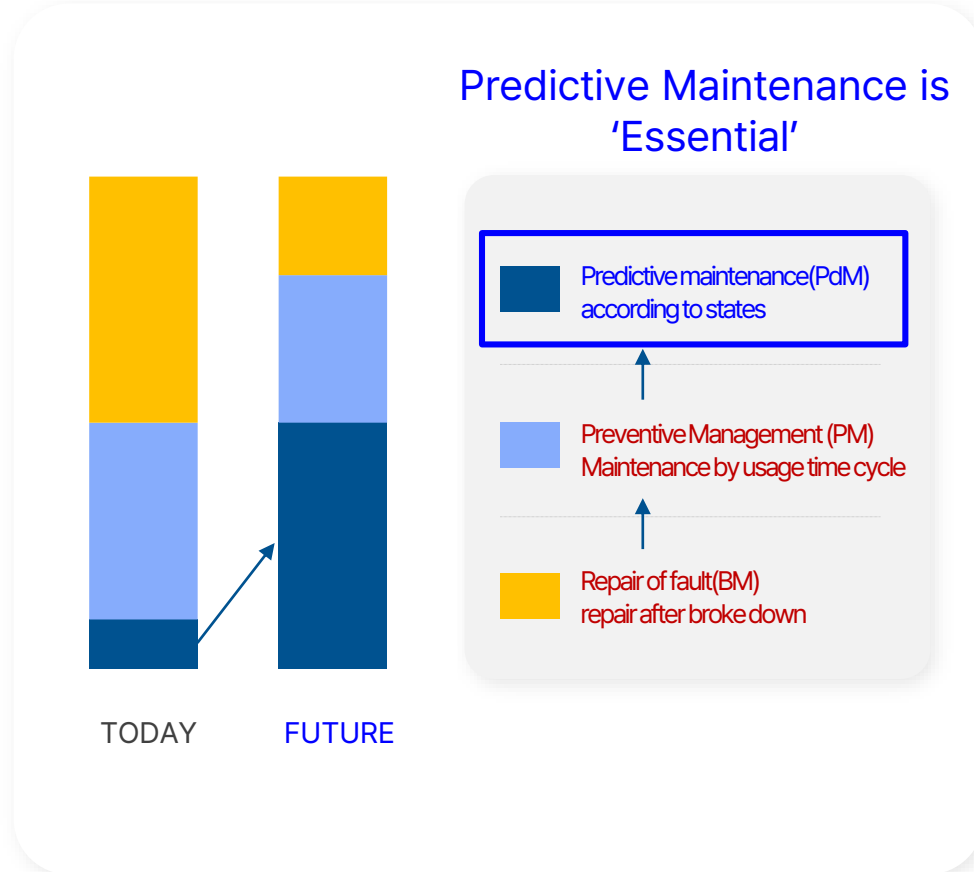
Machine failures result in **astronomical economic losses.**

질강협회 "포스코현대제철 고로 멈추면 8000억 손실"

5년간 원전 고장정지 54건... 전력판매 손실액 2조2480억원

707억 피해본 여수산단 정전, 전기설비 고장맞

구분	수익	손실액	발생건수	발생률	정전시간	정전률
13	373	1,469	113,768	88,217	790	290
14	430	100,947	163,124	264,271	264	264
15	1,212,274	96,633	217,897	217	217	217
16	1,068	178,867	393,299	572,166	136	136
17(합계)	44	96,113	305,432	401,545	402	402
총계	1,915	649,160	1,096,716	2,246,096	2,246	2,246



## Problem: Limitations of Traditional Approaches

- It is difficult for humans to **consistently diagnose** machine conditions.
- Traditional sensors **struggle to detect early signs of failure**.

### Expert experience



- Lack of **consistency**
- It takes a **long time** to develop **know-how**
- Difficulty in **assetization of knowledge**

### Vibration sensor



- **Install restriction by contact sensor**
- Low sampling make it difficult to analyze

### Electric current sensor



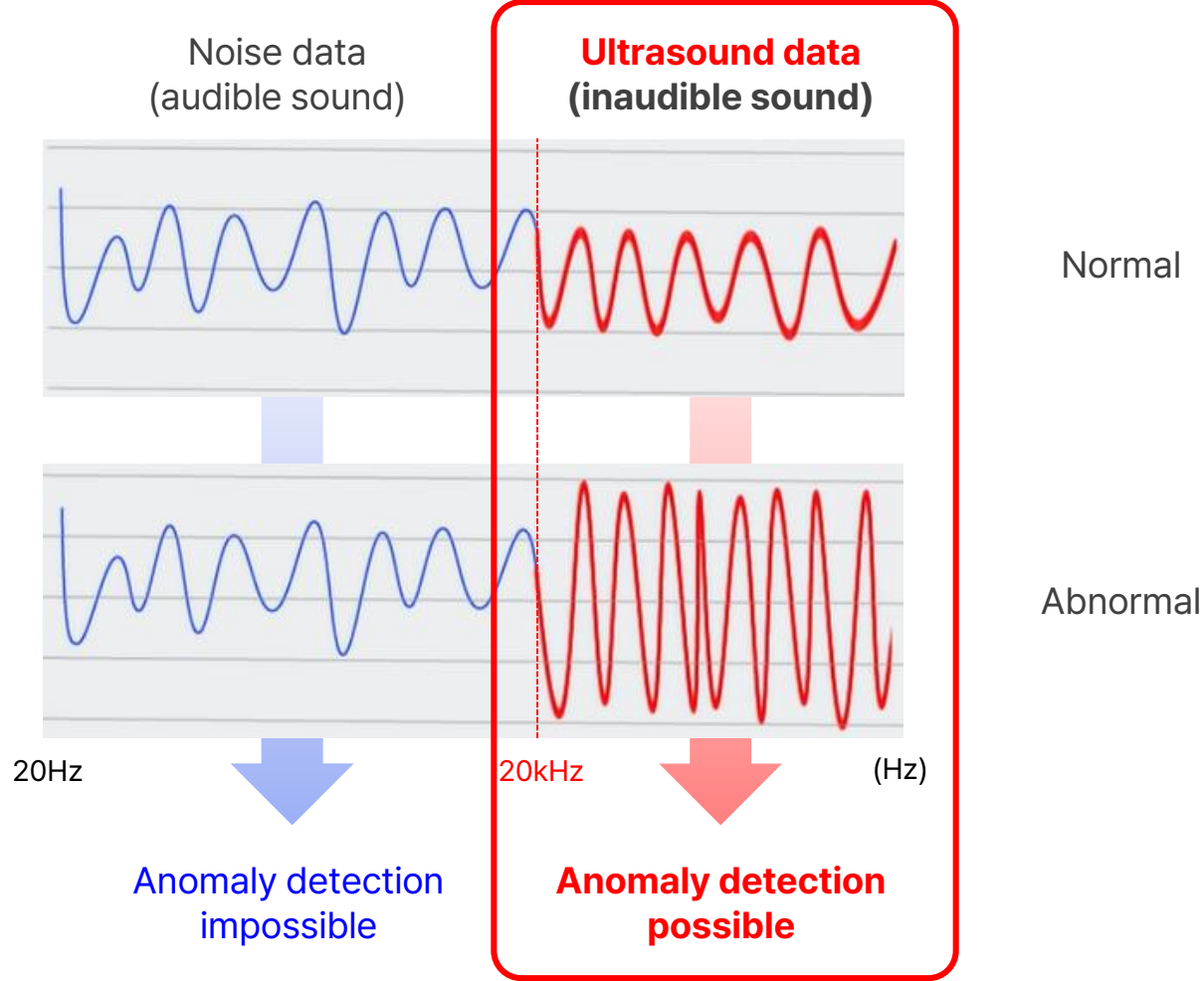
- Abnormal signal is generated just before the failure, limiting the precautionary preparation
- Overcompetitive risk due to low-cost sensors

# New sensing, New Insight 'Ultrasound'

- Detection of abnormal operation in manufacturing machine by analyzing acoustic data above 20kHz(ultrasound)



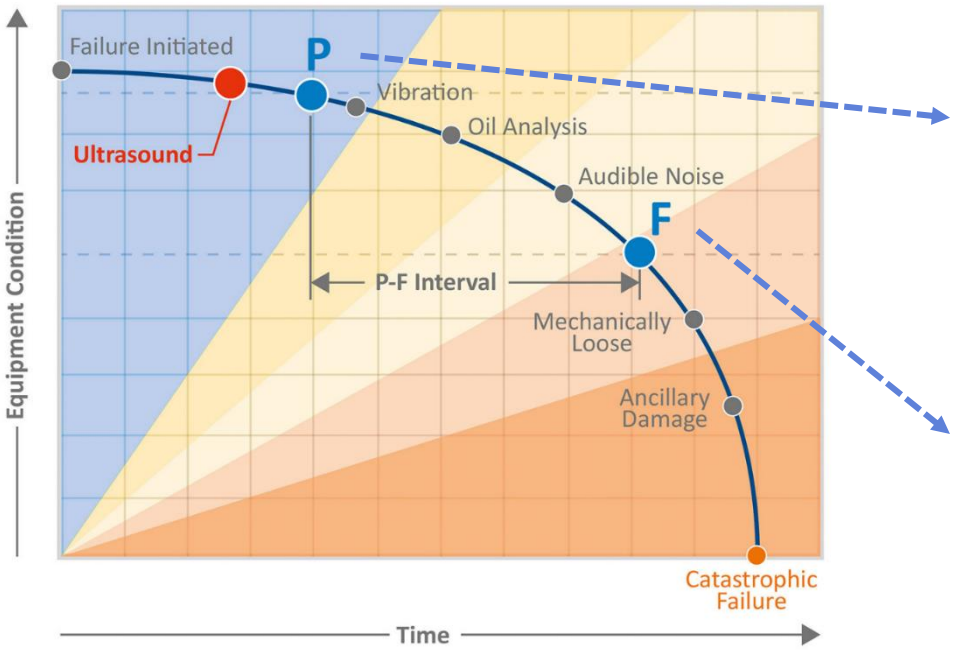
Receiving acoustic data generated during machine operation



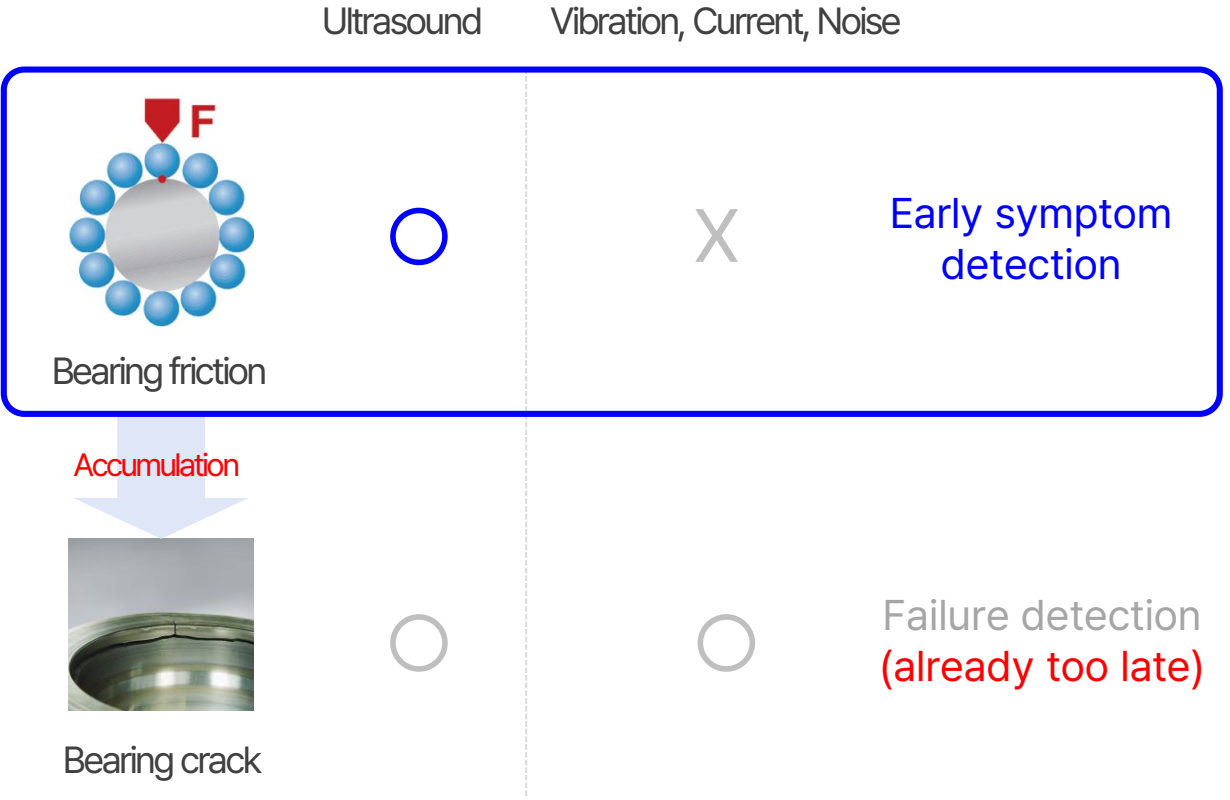
# Key Advantage 1: **Early Symptom Detection**

- Ultrasound data can detect **subtle changes(early symptoms)** caused by friction or collisions.
- When equipment failure occurs, vibration, current, and noise can all be detected, but by then **it's too late**.

## Ultrasound Is The First Line of Defence



**P** Potential Failure    **F** Functional Failure



## Key Advantage 2: **Non-contact** Installation

- Can be installed on equipment where contact-based sensors like vibration or **current sensors are difficult to use**, allowing for broader application.



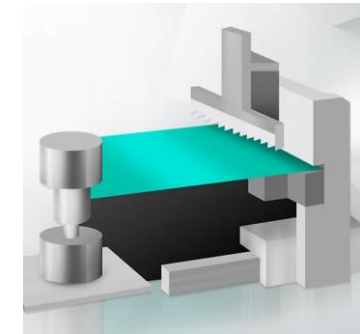
<Round surface>



<High-temperature surfaces>  
(above 70°C)



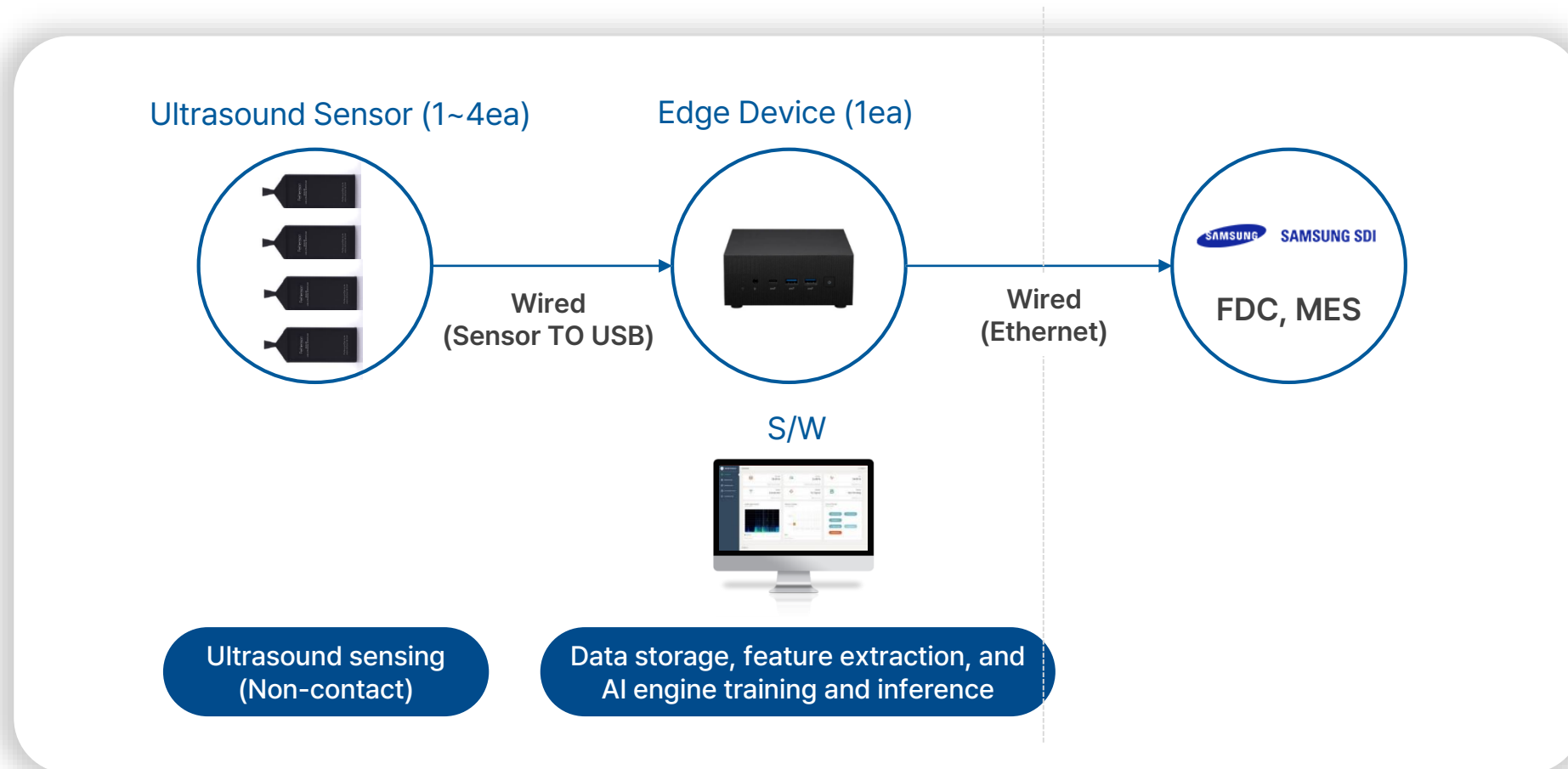
<Small machine>



<Dynamically operating machine>

## Solution introduction: Configuration Diagram

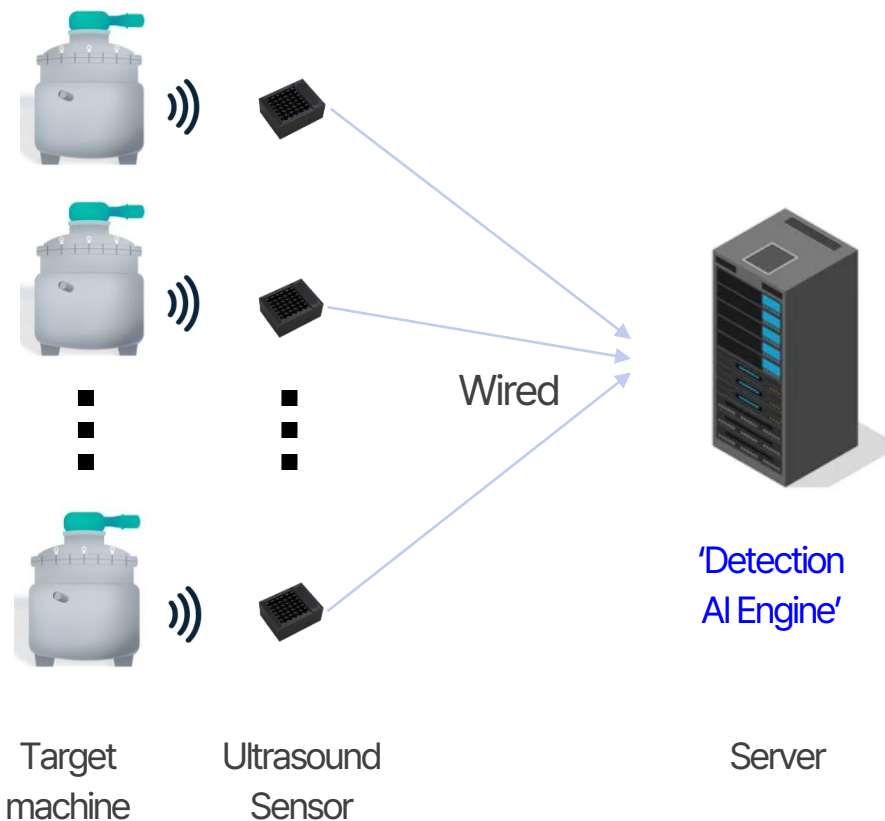
- Hardware includes 4 ultrasound sensors and 1 edge device with embedded software.
- Each set costs \$20,000, with annual maintenance at 15% of the software cost.



# Solution introduction: AI Service

- Providing a service to detect the condition of machine (AI engine) for facility managers, including normal, anomalous, and fault statuses.

### <System Configuration>



### < AI Service >

Learning from normal data to score machine anomalies.

① Alarm service for threshold exceedance

The graph plots 'Level' on the y-axis against 'time' on the x-axis. A horizontal line represents the 'threshold'. The data line fluctuates below the threshold but eventually rises sharply to cross it. A blue callout box labeled '알람' (Alarm) points to the point where the data crosses the threshold.

When anomalies or faults occur, The system learns patterns from accumulated data

② Anomaly Cause Identification Service  
③ Remaining Lifespan Prediction Service

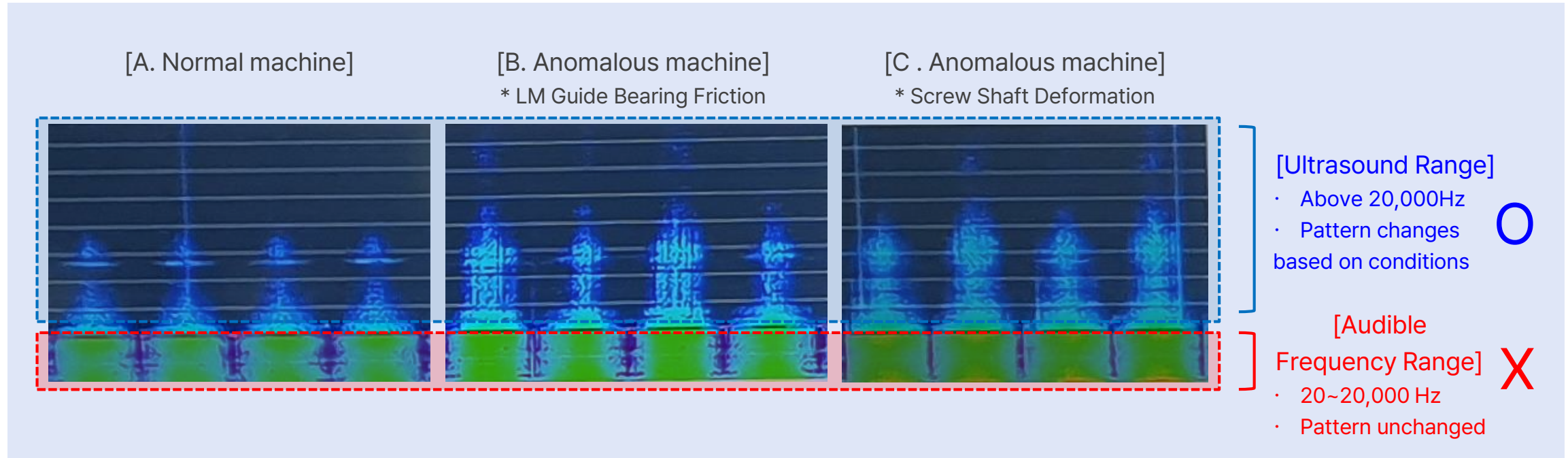
'Bearing fault'  
'30% Remaining Lifespan'

The image shows a computer monitor displaying a dashboard with various charts and data points. Below the monitor, the text indicates a detected 'Bearing fault' and a prediction of '30% Remaining Lifespan'.



# Solution introduction: Applications

- ① Anomaly Signal Detection ② Cause Identification ③ Remaining Lifespan Prediction Algorithm



Step 1: Implement anomaly signal detection algorithm (edge device) based on normal data.

Step 2: Identify actual causes of anomalies on-site and train the B.C cause identification algorithm with a few clicks in the system (server).

Step 3: Analyze patterns of anomalies up to the fault point to provide remaining lifespan prediction service (server).



# Use case 1: Dry Vacuum Pump

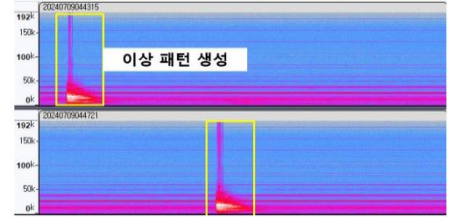
- Ultrasound successfully used for pre-failure pump prediction, undetectable by traditional methods, on mass production lines

EDWARDS pump pre-failure prediction

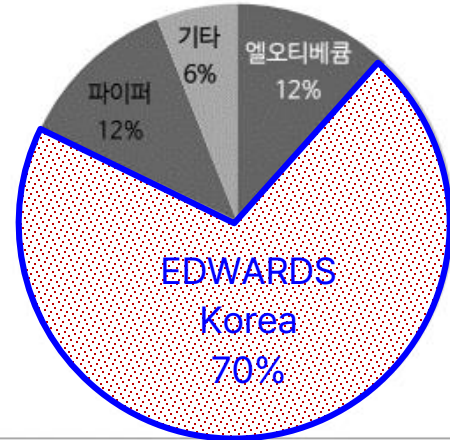
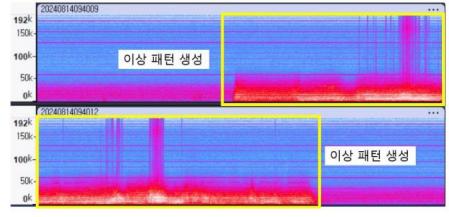
Top-tier manufacturers in domestic and global markets

Pump market : Domestic \$1.4B, Global \$5.6B

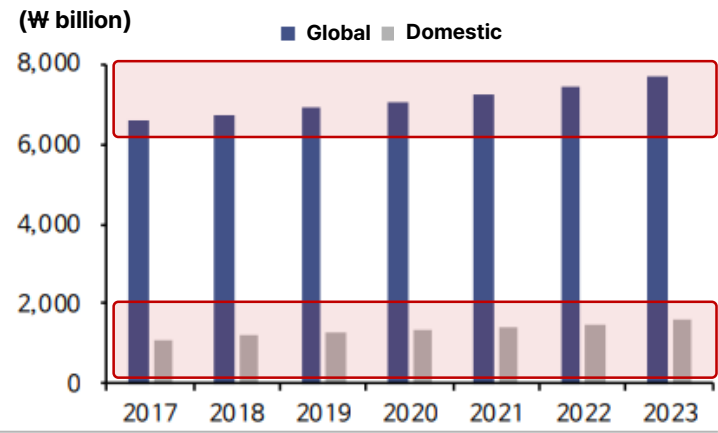
Case.1  
Predicted  
**12 hours**  
in advance



Case.2  
Predicted  
**20 hours**  
in advance



자료: 회사 자료, 신한금융투자 추정



자료: Mordor Intelligence, K-MAPS, 신한금융투자

**Estimated Pump PdM Market**  
: Domestic \$0.2B(70,000 units), Global \$0.6B (280,000 units)

\* The number of pumps is calculated based on a unit price of \$20,000 per pump  
\* Market size is estimated based on \$2,500 revenue per pump

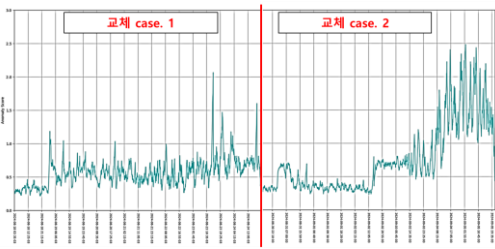


# Use case 2: Notching

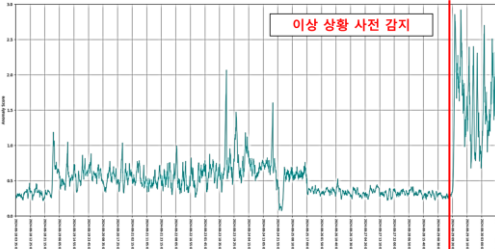
- **Ultrasound successfully** applied for monitoring and failure prediction of notching equipment, **undetectable by traditional methods**, in mass production

consumable replacement & failure prediction

Case.1  
Consumable replacement cycle prediction



Case.2  
Predicted 20 hours in advance



Global factories of major domestic companies fully operational by late '24 ~ '25

표 8. 국내 셀 3사의 장비 발주 및 가동 시점 전망 (■ = 장비 발주 □ = 가동 시점)

기업	국가	지역	라인 수	2021년		2022년		2023년		2024년		2025년	
				상반기	하반기	상반기	하반기	상반기	하반기	상반기	하반기		
SK온	중국	영성	4										
		항가리	12										
	미국	조지아	4										
		켄터키	17										
LG엔솔	중국	테네시	17										
		오호산	17										
	미국	오하이오(GM1)	3										
		테네시(GM2)	7										
삼성SDI	미국	미시간(GM3)	13										
		미정(GM4)	10										
	캐나다	에리존나	6										
	인도네시아	온타리오(스텔란)	16										
삼성SDI	미국	카러왕	5										
		스텔란	3										

Press → Laser → Back to Press

디일렉 · 2023.10.20.  
[영상] LG엔솔 노칭 장비 레이저에서 프레스로 급선회

전자부품 전문 미디어 디일렉 · www.thelec.kr · news  
레이저만 썼던 디이엔티, 배터리 장비 '프레스'도 추가  
2024.01.05. LG에너지솔루션과 주로 거래하는 배터리 장비기업 디이엔티가 노칭 공정을 이원화한다. 기존 레이저와 함께 프레스 방식을 추가했다. 노칭(Notching)은 양-음극판의 끝에 있는 탭(Tab)을 따주기 위한 공...

Despite next-gen laser notching tech, press is preferred due to technical challenges and automaker demands

Estimated Noching PdM Market : Domestic \$11M(1,000 units), Global \$44M (4,000 units)

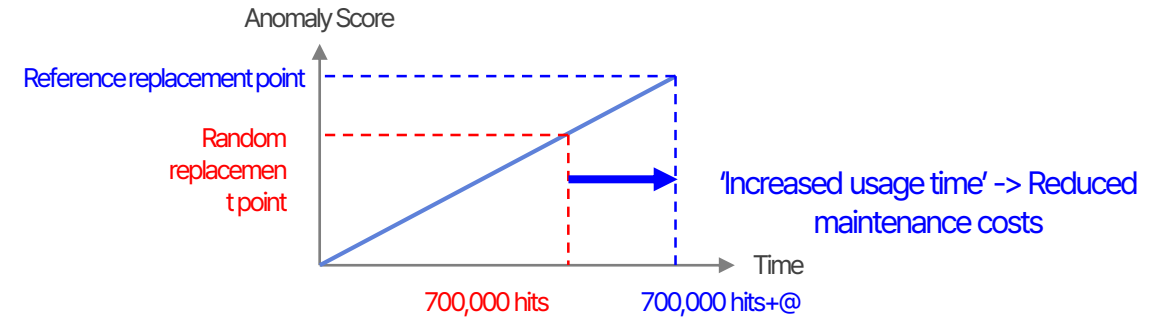
\* Estimated based on battery market share and number of production lines, with one press notching machine per line

## Use case 2: Notching

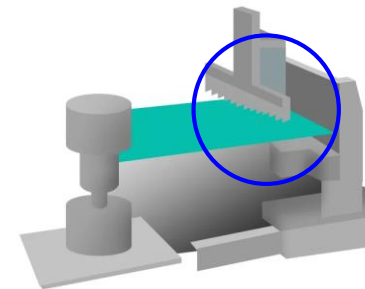
- Consumables that must be replaced due to wear

→ 'High cost' with a one-time replacement cost of approximately \$ 20,000

Target Machine	Detection of wear rate of parts in the process of cutting products Ex) Notching machine: Process of cutting to fit battery specifications
Importance	It is important to cut the product precisely (affects quality)
Problem	Replace cutting blades before quality is affected
Solution	Ultrasound analysis is used to determine the degree of wear, and replacement is made after optimal use before quality is affected.



'Friction' -> 'Ultrasound occur'






Only 70% of the standard stroke is used  
 Replace once every 60 days (6 times a year)  
 Costs 180 million won per year  
 Save 18 million won when lifespan is improved by 10%

<Notching machine>

# Competitive advantage

- Domestic competitors rely on **vibration and current** data; **only MOVIC Lab** use ultrasonic data.
- Vibration&current sensors have **limits**, and despite large investments, there has been **underperformance**, with some **pivoting**.

			
Type	Ultrasound	Current	Vibration
Target	Dry Pump, Cutting	Transformer	Motor
AI Tech	High	High	Low
Sales	0.1 M	2 M	1.5 M
Total investment	1.2 M	36 M	3.5 M
establishment	2017	2016	2014

**'Wide range of applicable machine'**

**'First to be validated'**

pivoting

underperformance

# Applications of Ultrasonic Technology

- Ultrasound from physical or electrical defects is used to diagnose issues across various fields.

## <Ultrasound Generation Principle>

**1. Physics**

<Friction>                      <impact>

**2. Electrical Fault**

<Corona, Arc fault>

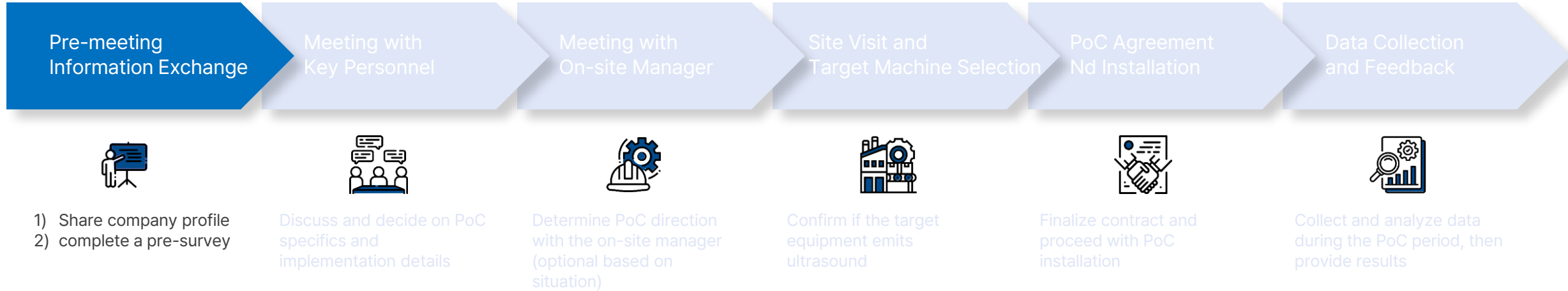
## <Applications>

<p><b>Mechanical Condition Monitoring</b> Predict problems before your bearings fail.</p>	<p><b>Bearing Lubrication Monitoring</b> Be proactive, grease bearings right.</p>	<p><b>Air &amp; Gas Leak Detection</b> Locate air and gas leaks. Save energy. Maximize uptime.</p> <p><b>Gas leak</b></p>	<p><b>Electrical Fault Detection</b> Safely inspect electrical systems.</p> <p><b>[Electrical]</b></p>
<b>[ Manufacturing ]</b>			
<p><b>Steam Trap Testing</b> Keep your steam clean, safe and energy-efficient.</p>	<p><b>Hydraulic systems monitoring</b> Detect leakage, by-passing and blockages.</p>	<p><b>Valve condition monitoring</b> Detect leaks and blockages, maintain flow and prevent waste.</p>	<p><b>Underground tanks tightness testing</b> Collect and amplify the ultrasounds generated by leaks.</p>
<b>Pipeline</b>			

Source: <https://sdtultrasound.com/> (2023.07.25)

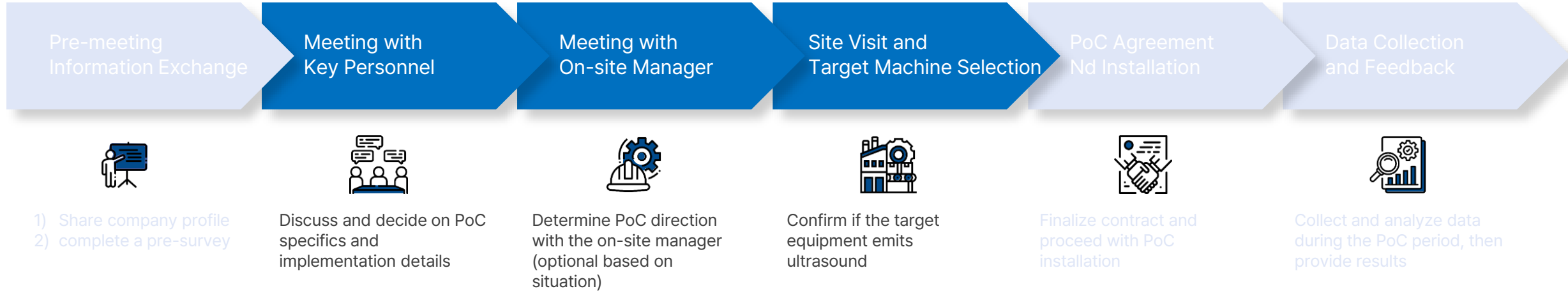
# PoC Process Overview

- Step. 1



# PoC Process Overview

- Step. 2



## PoC Feasibility (Technical/Business)

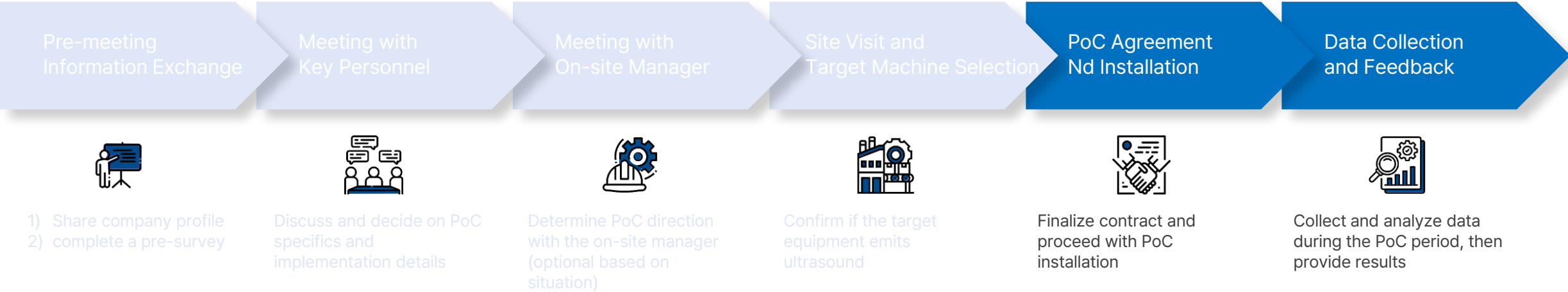
- Confirm installation feasibility
  - Requires a stand and AC 220V power (extension cord needed)
  - Not suitable for high temperature or high humidity environments(must be within human activity range)
- PoC cost (minimum 2 units)
  - 1 ultrasonic sensor (1 point), installation, removal, data analysis
  - approx. \$1,000 per unit





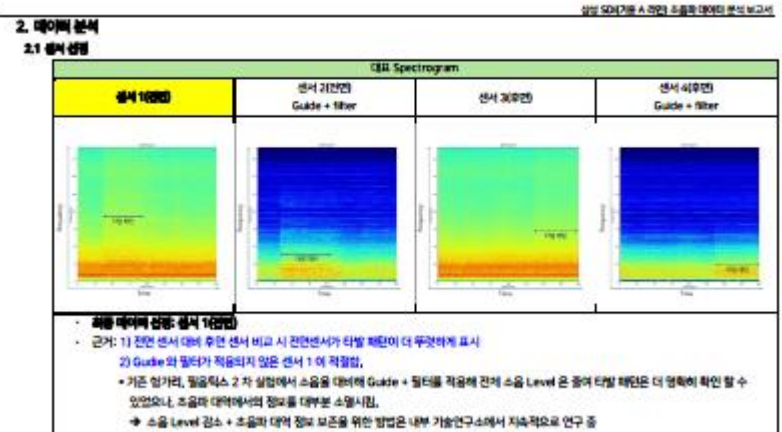
# PoC Process Overview

- Step. 3



## Failure or fault data is essential for validation

- Fab (Manufacturer or in-plant)
  - Simulate a fault
- Mass production line
  - Install on equipment with a high likelihood of failure to target real fault scenarios
- Test Case
  - Discuss and finalize testing conditions (installation, frequency, etc.)



<Sample Report>

# New Sensing New Insight

